



Land Application of Biosolids

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- Wastewater treatment conveys PFAS into the environment via residuals which are often applied as an agricultural amendment. The data gaps include:
 - Lack of knowledge regarding the fate of PFAS in land applied biosolids and other PFAS-containing land applied residuals
 - Lack of knowledge regarding the transport of PFAS in the subsurface
- ORD will collect data to characterize PFAS concentrations, transport, and transformation in biosolids land application and other soil and subsurface settings
 - Collecting data to assess current practices and to support model development
 - Developing improved models to describe PFAS fate and transport
 - Adapting current modeling approaches to more accurately describe PFAS fate and transport
- Our partners: OW(OST); OLEM(ORCR, FFRRO); EPA Regions; states; and industry groups



Approach

Collecting data to assess current practices

Data Gap: Lack of knowledge regarding the fate of PFAS in land applied biosolids

Actions:

1. Field Study 2 – Evaluate application of liquid and solid biosolids. Evaluate natural attenuation for various analytes including PFAS
 - Single application, controlled pilot scale study
 - Focus on top 2 inches of soil
 - Measured PFAS, nonylphenol, metals, and microbes over year-long study



2. Field Study 3 – Evaluate PFAS soil concentrations at a field site as a function of depth and biosolids loading
 - Biosolids have been applied for over 20 years
 - Measuring PFAS in soils. Also measuring PFAS in crops
 - Measure PAHs, alkylphenols, metals and nutrients

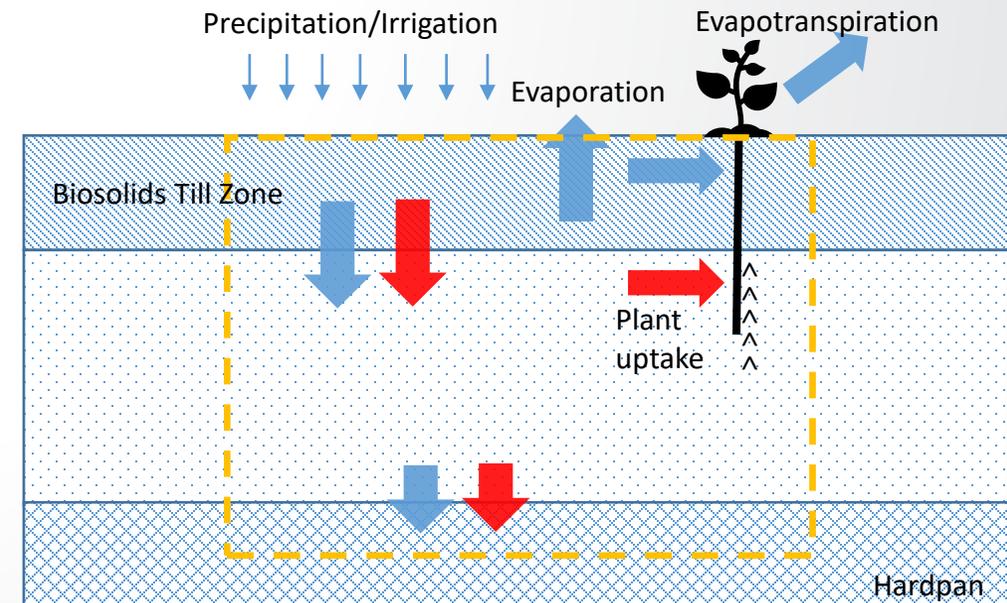


Approach PFAS transport in the subsurface

Data Gap: Lack of knowledge regarding the transport of PFAS in the subsurface and need to adapt tools to improve accuracy

Actions:

1. Conduct literature review and compile soil sorption coefficients, identify key site characteristics
2. Field Study – Valmont Superfund Site (Region 3)
 - Measuring PFAS soil and groundwater concentrations near the groundwater interface at a field site with co-contaminant VOCs
 - Evaluating extraction methods
 - Measuring groundwater VOCs, metals, and anions
3. Adapt current modeling approaches to more accurately describe PFAS fate and transport
4. Investigate and develop conceptual models of PFAS source zones with the goal of predicting PFAS concentrations
5. Applying conceptual model to biosolids application sites and compare to real world data





Current Status

Collecting data to assess current practices

- Field Study 2
 - Sample collection and data review completed
 - Data interpretation continuing
 - Completed documents
 - EPA internal report
 - Presentations to Michigan Water Environment Association, US EPA Biosolids webinar
 - Manuscript to be submitted shortly
- Field Study 3
 - Sample collection – to be completed this week

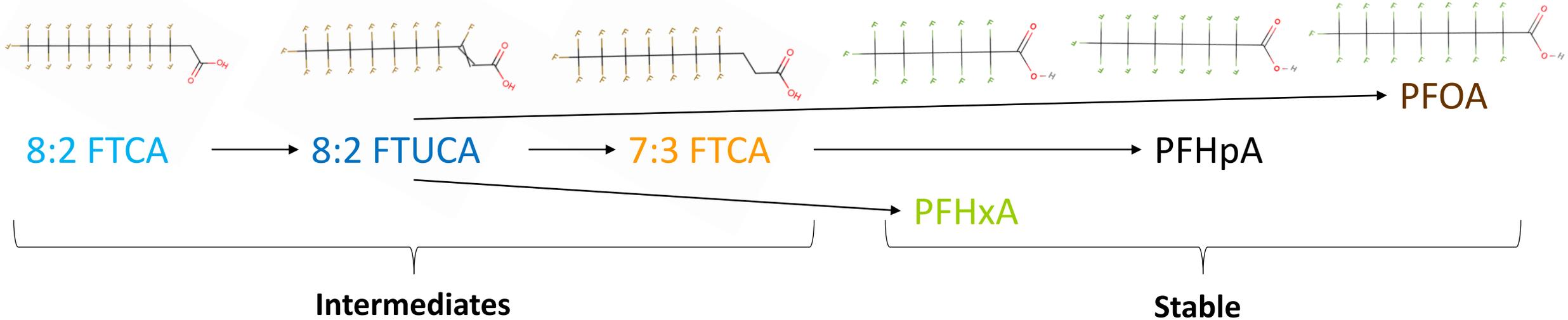




Current Status

Collecting data to assess current practices

C8 oxidation pathway



Field Study 2

- Initial concentrations of intermediates > stable PFAS
- After a year, concentrations of stable PFAS 4 to 33 times higher than initial value
- Data consistent with oxidation of PFAS intermediate to form stable PFAS over the course of the study

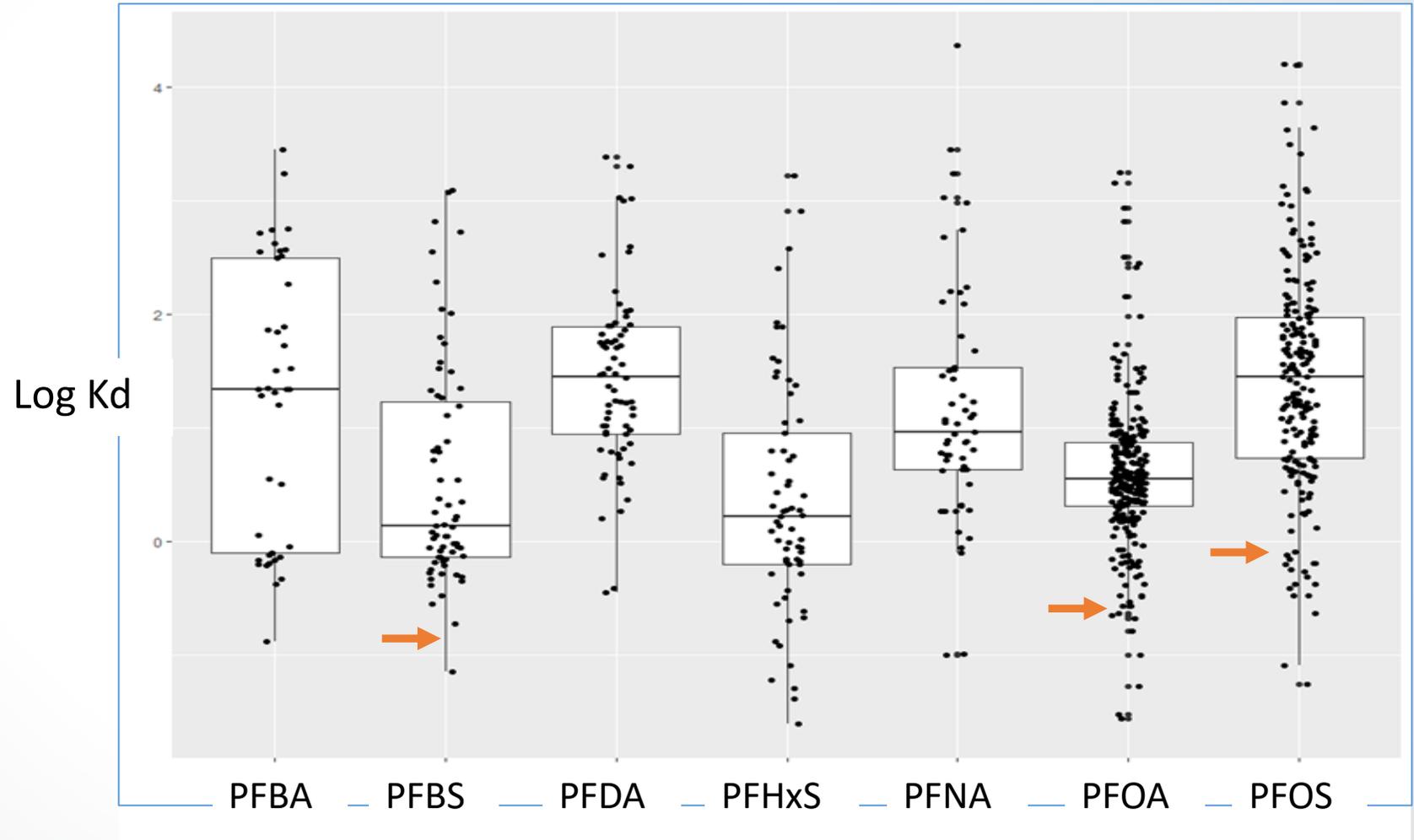


Current Status

PFAS transport in the subsurface

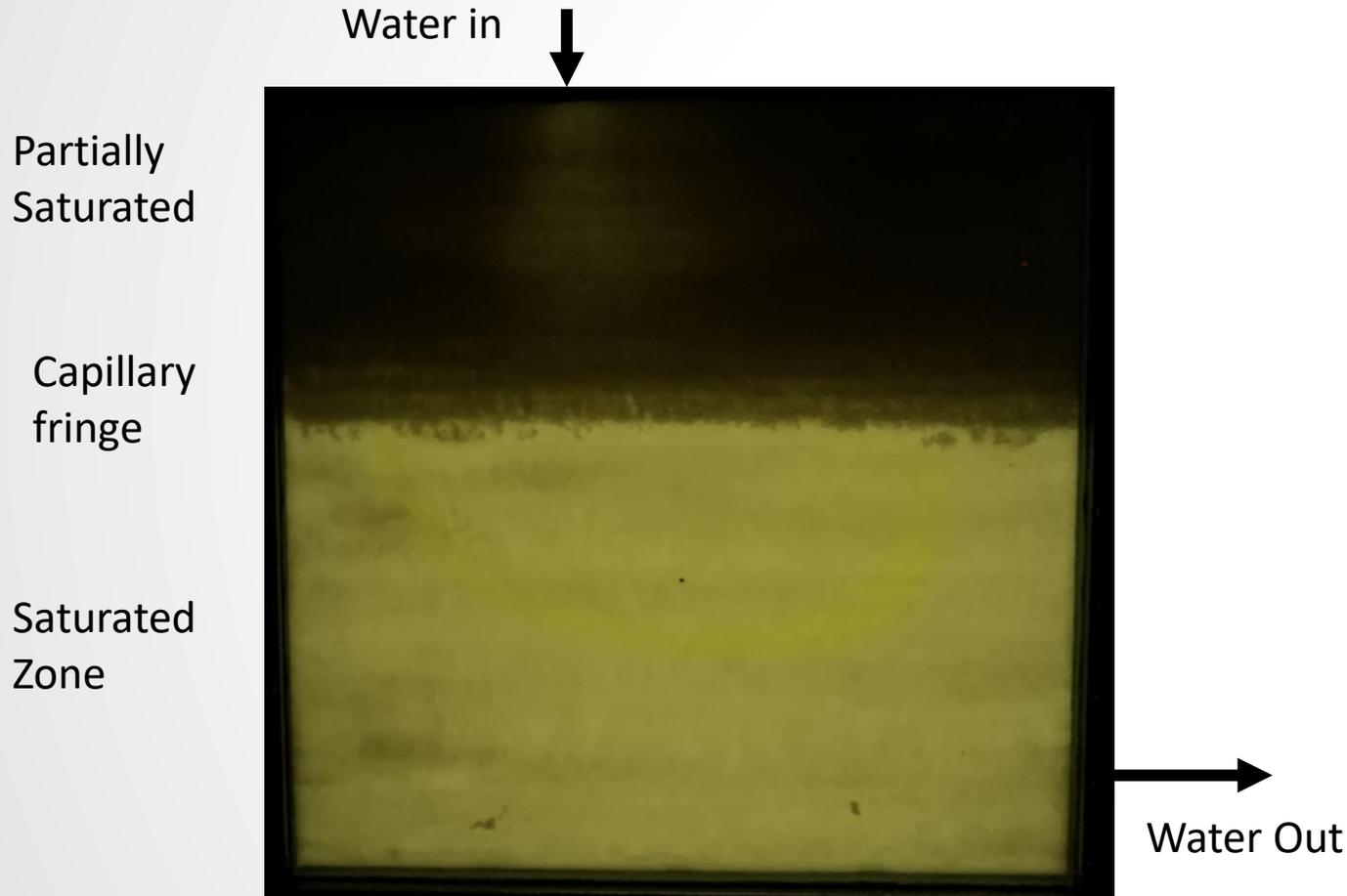
Actions:

1. Conduct literature review and compile soil sorption coefficients, identify key site characteristics
 - initial assessment completed
 - paper accepted (Rovero, M., Cutt, D., Griffiths, R., Filipowicz, U., Mishkin, K., White, B., Goodrow, S., Wilkin, R.T. (2021). Limitations of current approaches for predicting groundwater vulnerability from PFAS contamination in the vadose zone, Groundwater Monitoring and Remediation).



Current Status

PFAS transport in the subsurface



Two Dimensional Model System – Thin box filled with aquifer material. Light indicates water saturated areas. Darker areas are partial saturated.

Actions:

2. Field Study – Valmont Superfund Site (Region 3) – samples collected in August
3. Adapting current approaches to more accurately describe PFAS fate and transport – comparing data to model predictions
4. Developing conceptual models of PFAS source zones – conducting in lab testing of PFAS movement in 2 dimensional systems
5. Applying conceptual model to biosolids application sites and compare to real world data – collecting samples this week



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